

Microscopic description of laser induced femtosecond structural changes in solids

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The interaction of intense femtosecond laser pulses with covalent solids gives rise to ultrafast bond breaking processes, which lead to structural changes, melting and ablation.

We have studied such ultrafast nonequilibrium phenomena by using a theoretical approach based upon molecular dynamics simulations on time-dependent potential energy surfaces.

In this talk, different examples of laser induced collective atomic motion in carbon and silicon will be discussed.

For instance, the mechanisms for the femtosecond ablation of diamond and graphite films will be analyzed. It will be shown that intense femtosecond pulses may induce nonequilibrium transitions of diamond into graphite and of graphite into low density liquid carbon on subpicosecond time scales.

Furthermore, the ultrafast melting of silicon, accompanied by a metalization process, and the ablation of silicon films will be studied as a function of the laser pulse duration.

Finally, the possibility of observation of these phenomena with the help of subpicosecond x-ray pulses will be discussed.